Accounting for finance is key for climate mitigation pathways

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Panel on Climate Risk Scenarios

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Source: Battiston S., Monasterolo I., Riahi K., van Ruijven B.J., Accounting for finance is key for climate mitigation pathways, ***Science****: 10.1126/science.abf3877.*

Use of climate mitigation scenarios for climate stress test is not new

- First scientific approach to assess climate-related financial risk based on IPCC mitigation scenarios developed by process-based IAM scenarios: Battiston ea. 2017's **climate stress test** (Nat. Clim. Ch.):
  - **translates IAM** trajectories into **financial shocks** on securities (price adjustment)
  - introduces **Climate Policy Relevant Sectors:** categories of transition risk based on NACE4 codes (EIOPA 2018, ECB 2019-2021, EBA 2020, ESMA 2020)
  - runs **climate-stress test** of the financial system and individual institutions, embedding climate scenarios into financial network models
- Approach applied to supervisory data: Roncoroni ea. 2021 *J.Fin.Stab*.; Gourdel ea. 2021 with ECB (*double materiality of climate risks*)

IAMs for climate financial risk assessment

- IAM produce a set of archetypical climate mitigation scenarios of how the transition could happen, **constrained** by physics and technology:
  - **Key dimension is timing** of carbon price (2020, 2030)
  - **temperature** target (1.5C, 2C)
  - reliance on Carbon Dioxide Removal
- **This is where notion of risk is key:**
  - Whereas investors' preferences differ wrt risk aversion and investment strategies, they all make investment decisions based on their assessment of risk.

- **Challenge**: IAM scenarios don't account for role of the financial system nor investors' decisions:
  - **Investments** assumed to be available **without frictions** (no credit constraints)
  - **There are no financial actors** that decide whether to make an investment or not
  - Trajectories don't reflect impact of financial risk assessment on scenarios (eg **endogenous** change in interest rate for climate risk exposed firms)
- *Thus, financial risk associated with each scenario can be underestimated*

What's missing in the NGFS-IAM scenarios?

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1. The Network for Greening the Financial System (NGFS)- IAM scenarios are now a **reference tool** for climate stress test:
   - They have the power to **shift markets' expectations**
2. But **NGFS scenarios don't account for the role of finance** in realization of climate scenarios, thus missing a key point: the **endogeneity** of risk:
   - Investors are looking at scenarios and adapt risk expectations across scenarios
3. **Embedding this feedback loop in mitigation scenarios is crucial to analyse the conditions for finance to enable/hamper the transition:**
   - Can lead to under-investing wrt to climate targets: achieving/missing the transition
   - Key for **political economy** of transition: fiscal and financial policy effectiveness
4. **We develop a framework to model the investors' expectations-policy- scenarios interaction**: it generates new scenarios that are more coherent w/investment needs, climate targets

The missing macro-financial feedback loop

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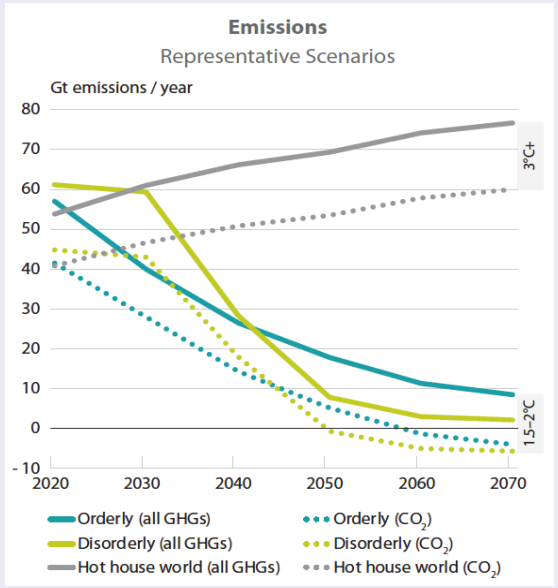
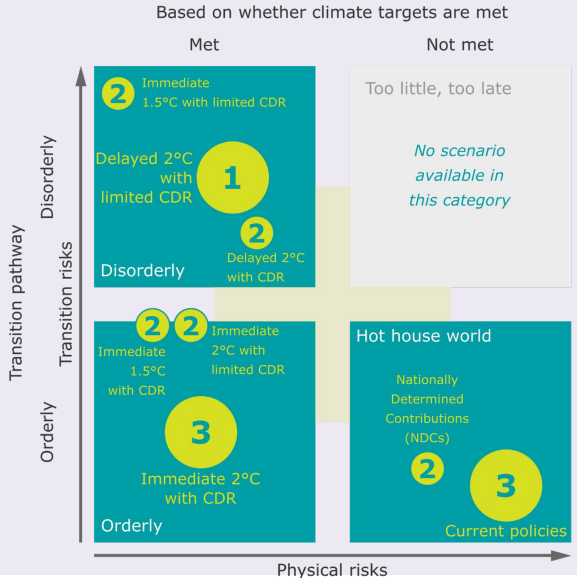
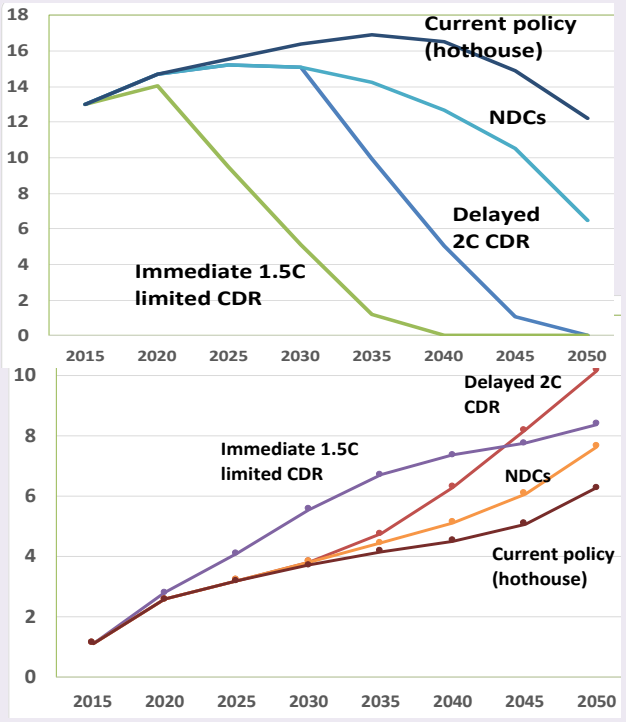
Climate scenarios

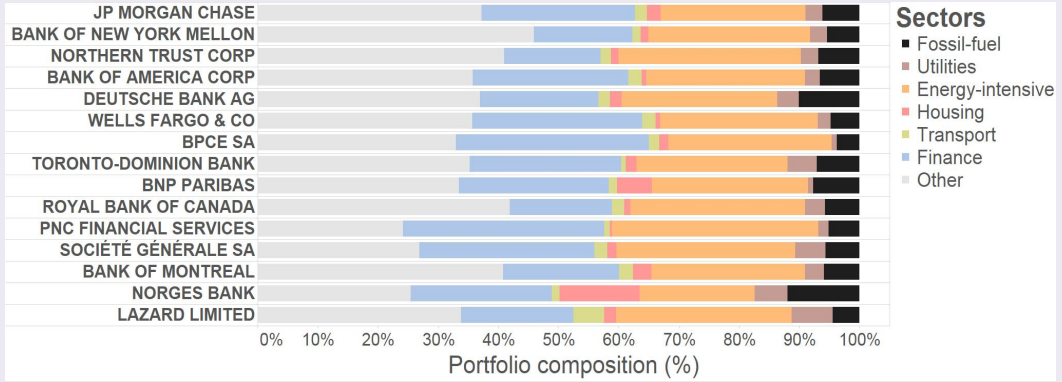




Economic scenarios (sector output, IAM)

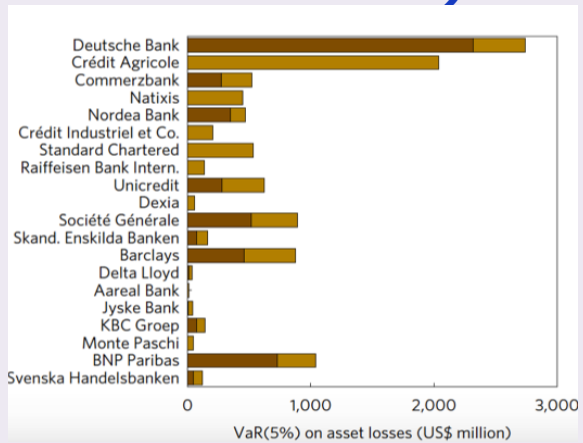


Climate risk exposures *(disclosure)*



Battiston ea (2017)

Climate-adjusted asset *valuation (climate stress-test)*



Battiston ea (2017)

Missing!

New investments and capital reallocation

Missing!

From climate scenarios to financial risk analysis: bridging the gap

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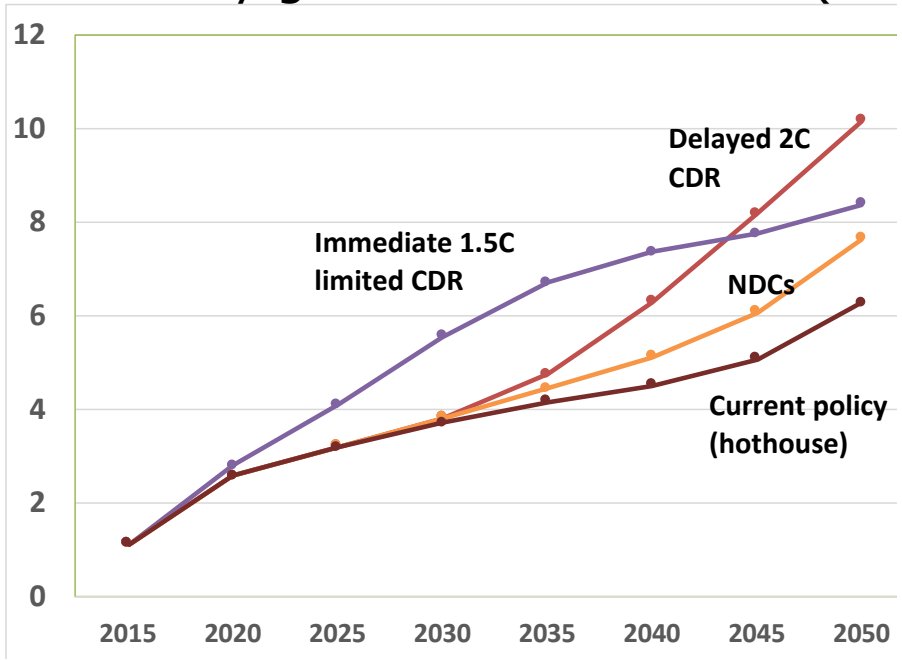
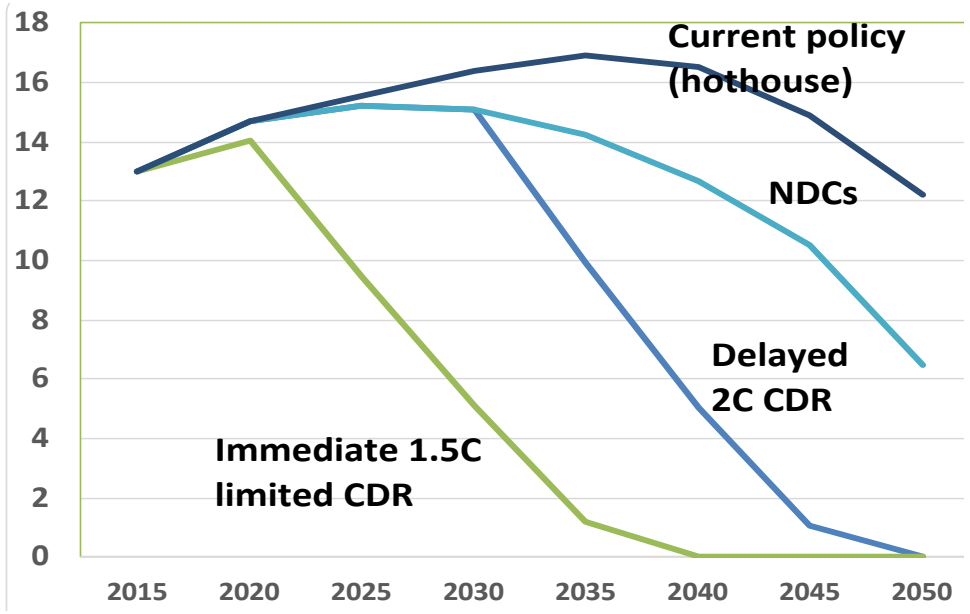
Electricity generation from wind (left)/coal (right), China, 2020-2050, REMIND-Mag-Pie.





Utility firm seeking funds to **shift its power plants** from **high to low-carbon** tech:

- If bank perceives low-carbon strategy as **less risky** than status quo (credible climate policy) → **lowers** interest rate on loan, thus **facilitating** firm's technological conversion.
- If bank perceives low-carbon as **more risky** than status quo (climate policy **non credible)** → **higher** interest rate on the loan, thus **delaying** the firm's technological conversion.

Adding the key dimension: the enabling or hampering role of finance

Enabling:

Investors perceive high physical risk from missed transition/high opportunities successful transition (**credible climate policies,** Rogge ea. 2018*)*

→ They reallocate capital into low-carbon investments early and gradually and even anticipate policy impact: **climate sentiments** (*Dunz ea. 2021)*

Hampering:

Investors interpret "orderly transition" as high-carbon firms only slightly more risky than low-carbon: expect firms to adjust tech mix and spread stranded assets over time because **climate policy not credible**

→ Capital reallocation not sufficient to fund investments assumed in scenario. Transition more costly for society due to abrupt reallocations of capital and price adjustments.

If a risk scenario is associate with too low-risk perception can make the scenario unfeasible

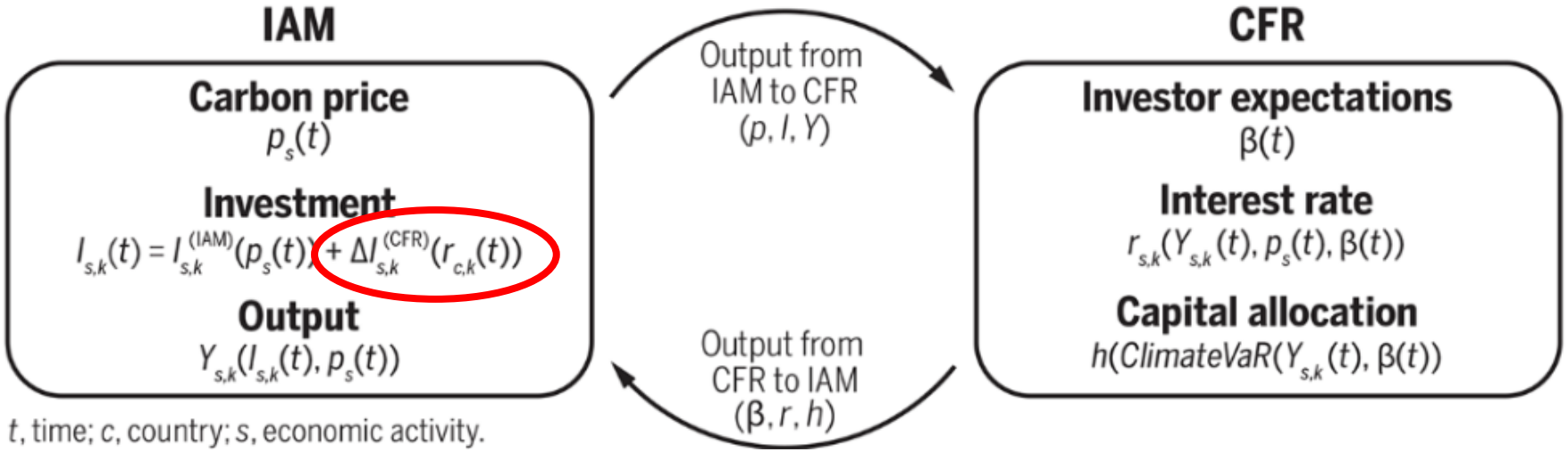
(Source: Battiston ea 2021, Science)

A framework to link IAM scenarios with Climate Financial Risk (CFR) model

- Captures interaction **expectations-scenarios** generating new scenarios more coherent with investment needs climate targets:

1. **IAM** generates economic output trajectories under climate policy scenarios
2. **CFR** uses IAM output to compute **interest rates** (r) for firms using different energy technologies (k)
3. Investors' **expectations** (β), climate **Value-at-Risk** determine capital allocation across tech
4. **IAM updates *r*** to reflect diversity in financing costs
5. **Repeat**

Set of IAM scenarios



t, time; c, country; s, economic activity.

CFR: models financial risk of high/low-carbon firms along scenarios

Source: Battiston ea (2021), Science

Why accounting for finance and its complexity in climate scenarios matters?

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1. **Produce more realistic orderly/disorderly trajectories of transition**: **endogenous**, based on interplay between inestors' adaptive expectations – climate policy timing and credibility – firms' investment (low/high carbon tech)
   - Orderly/disorderly dimensions is exogenous in current NGFS scenarios; financial behavior by assumption or friction; financial risk assessment is missing
2. Avoid underestimate **investment needs** to achieve 1.5/2C scenarios
3. **Avoid underestimate financial risk in climate stress tests**:
   - Investor's PDs and VaR very sensitive to the choice of adverse scenario and its probab, Battiston and Monasterolo 2020)
4. **Assess the double materiality of climate risks** (Gourdel ea 2021)

Trajectories from IAM-CFR framework

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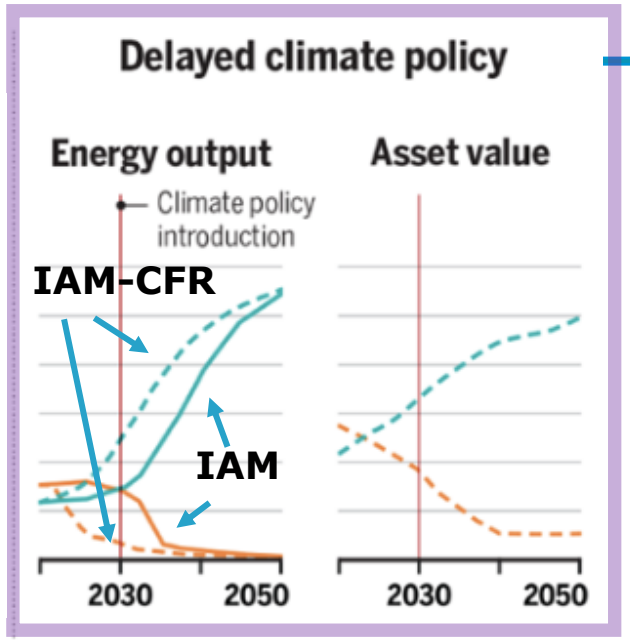
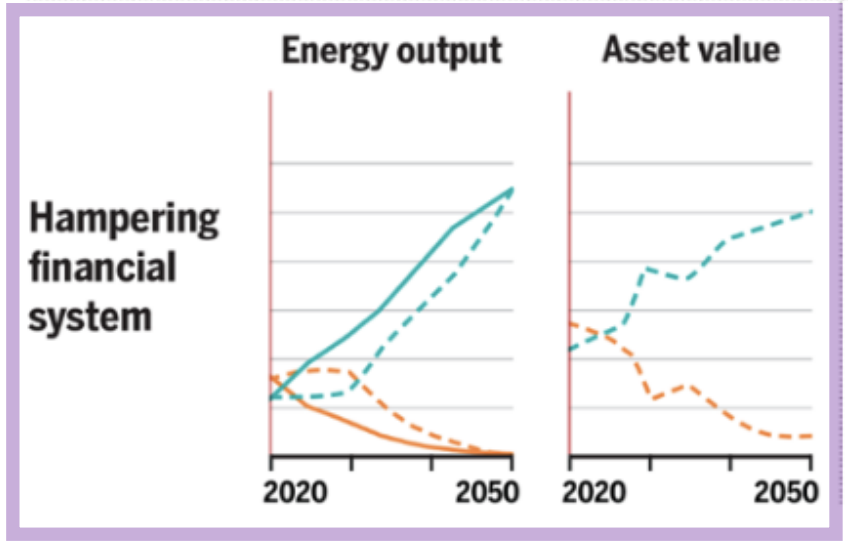
Policy →

Finance ↓

Enabling financial system



Hampering financial system



Source: Battiston ea (2021), Science

Endogenizing orderly/disorderly transition:

- An immediate transition to 2°C classified in NGFS scenarios as orderly. But in hampering case: delayed transition, large and sudden financial value adjustments as in a disorderly scenario.
- A delayed transition to 2°C classified disorderly. But in enabling case gradual price adjustments more consistent with orderly
- In hampering role: disorderly transition could also lead to higher risk than in NGFS disorderly

Legend:

Assessing the macrofinancial relevance of climate risks: the way forward

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- Traditional macroeconomic models used for financial policy (Computable General Equilibrium (CGE), Dynamic Stochastic General Equlibrium (DSGE)
  - BUT finance missing or stylized (friction); solving to equilibrium doesn't allow to capture non-linear dynamics induced by climate risk
- **Opportunity**: Stock-Flow Consistent (SFC) models (Dafermos ea 2017,2021,Monasterolo & Raberto 2018, Dunz ea 2021, Gourdel ea 2021):
  - Finance (and risk) not by assumption or design but endogenously modelled
  - Endogenous economic-financial agents' interactions and feedbacks: impact of expectations and policies on investment decisions and **co-benefits**
  - Assessment of dynamic feedbacks climate scenarios -economy-finance, complementing static stress tests (incl. ECB)
- Embedding IAM-CRF with SFC to assess the **double materiality of climate risks: dynamic climate stress test** (Gourdel ea 2021, Battiston ea 2021).

Thank you!

- Battiston S., Monasterolo I., Riahi K., van Ruijven B.J., Accounting for finance is key for climate mitigation pathways, *Science*: 10.1126/science.abf3877

- *Comments/questions: irene.monasterolo@wu.ac.at*

Implications for climate policies and climate stress test

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- **Our framework contributes to strengthen policy signal and policy credibility:** crucial role for low-carbon transition and financial stability

Fiscal policies:

- Neglecting role of finance implies **carbon price projections** could miss **emissions target:** mitigation scenario does not necessarily imply risk perception by financial system that leads to investment reallocation assumed by the scenario. Similarly, for carbon subsidies phasing out.
- Thus, IAM-CFR framework could help IPCC community and NGFS to **revise carbon price projections** to be more consistent with role of financial system

Financial policies:

- IAM-CFR could support financial authorities and investors in **limiting underestimation of financial risk in climate stress-test exercises**
- Implications for **asset eligibility crit**eria in central banks' collateral frameworks and asset purchasing programs (e.g. Quantitative Easing)